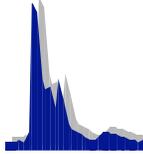


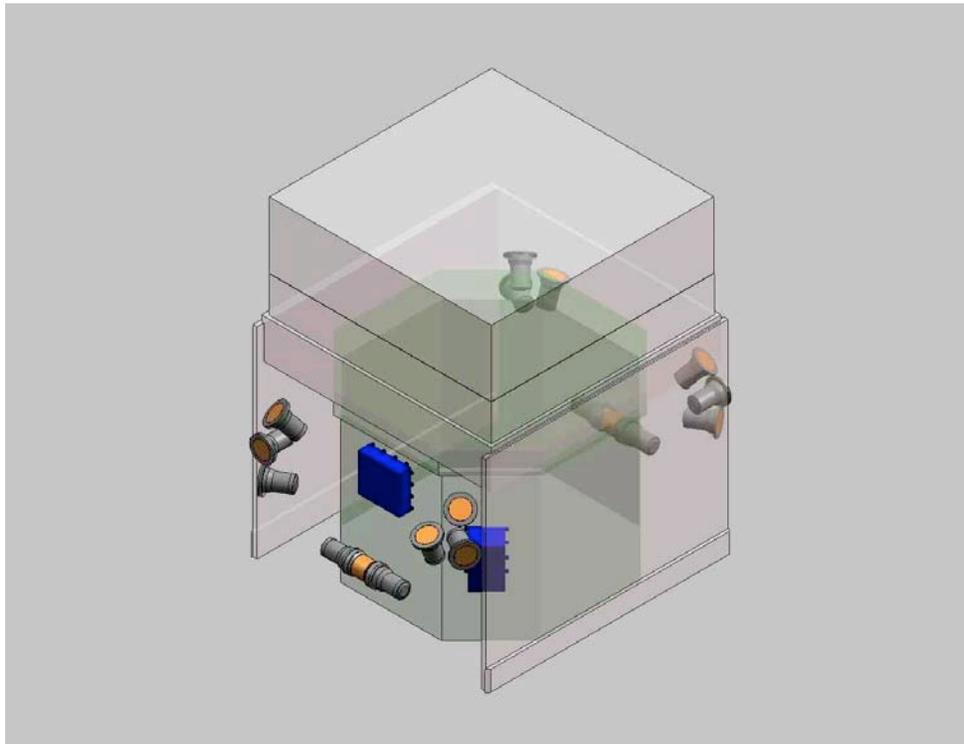
GBM Trigger, Calibration, and Response Review

Trigger and On-Board Algorithms – Chip Meegan
Calibrations – Jerry Fishman
Response Matrices – Marc Kippen



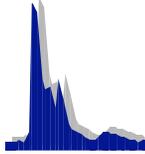
The GLAST Burst Monitor

**Purpose: Extend GLAST spectra of GRBs from LAT threshold down to 10 keV;
alert LAT to strong bursts outside its field of view.**



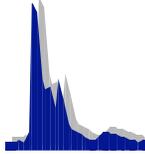
Energy Range:
10 keV to 30 MeV.

Detectors:
12 NaI, 5" diameter x 5" thick;
2 BGO, 5" diameter x 5" thick.



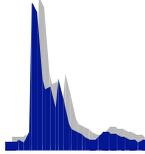
BATSE Burst Trigger

- ♠ Energy range: 50 – 300 keV
- ♠ Time Scales: 64, 256, and 1024 ms
- ♠ Significance: nominally 5.5 sigma in at least 2 detectors
- ♠ Background: computed every ~17 s
- ♠ Threshold: ~0.2 photons/cm²-s
- ♠ Rate: ~300 per year
- ♠ 93% of triggered bursts were above the 1024 ms threshold



GBM Burst Trigger

- ♠ Energy range: 3 programmable, incl. 50 – 300 keV
- ♠ Time Scales: 16, 64, 256, 1024, 4096, 16384 ms
- ♠ Significance: nominally 4.5 sigma in at least 2 detectors
- ♠ Background: flexible algorithm, quadratic fit
- ♠ Threshold: ~0.7 photons/cm²-s
 - λ Requirement: 1.0 photons/cm²-s
 - λ Goal: 0.75 photons/cm²-s
- ♠ Rate: ~200 per year (BATSE-like trigger)

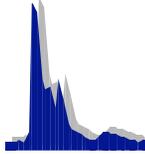


On-Board Locations

- ♠ Grid search to match relative rates of NaI detectors
- ♠ Grid size of 1634 points – 5 degree resolution
- ♠ Assume typical spectrum and zenith pointing
- ♠ Systematic errors
 - λ Grid discreteness
 - λ Spectral variations
 - λ Off-zenith pointing

Zenith angle (deg.)	1 sigma error (deg.)	2 sigma error (deg.)
0	3	6
15	3	7
30	4	10
45	6	14
60	7	21
75	9	29
90	13	40

GBM meets accuracy goal at any zenith angle.



On-Board Trigger Classification

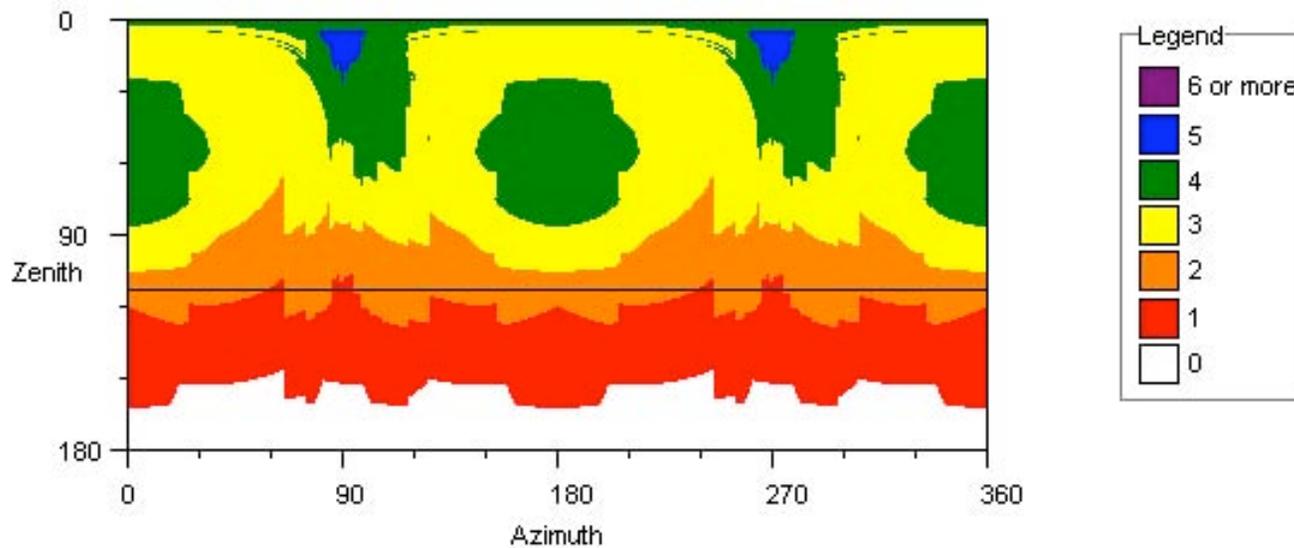
- ♠ **Bayesian approach**
- ♠ **Algorithm developed and tested**
- ♠ **Classes: GRBs, Solar Flares, Particle Precipitation (local and distant), Hard X-Ray Transients (known and generic), SGRs (known and generic), Cygnus X-1, TGFs**
- ♠ **Parameters: Location, Hardness Ratio, Geomagnetic Latitude**
- ♠ **Always fooled by a new hard X-ray transient**
- ♠ **About 95% of GRBs classified correctly – other 5% ambiguous**

Effective Area and Field of View

♠ **Field of View: 9.5 steradians**

λ **Requirement: 8 steradians**

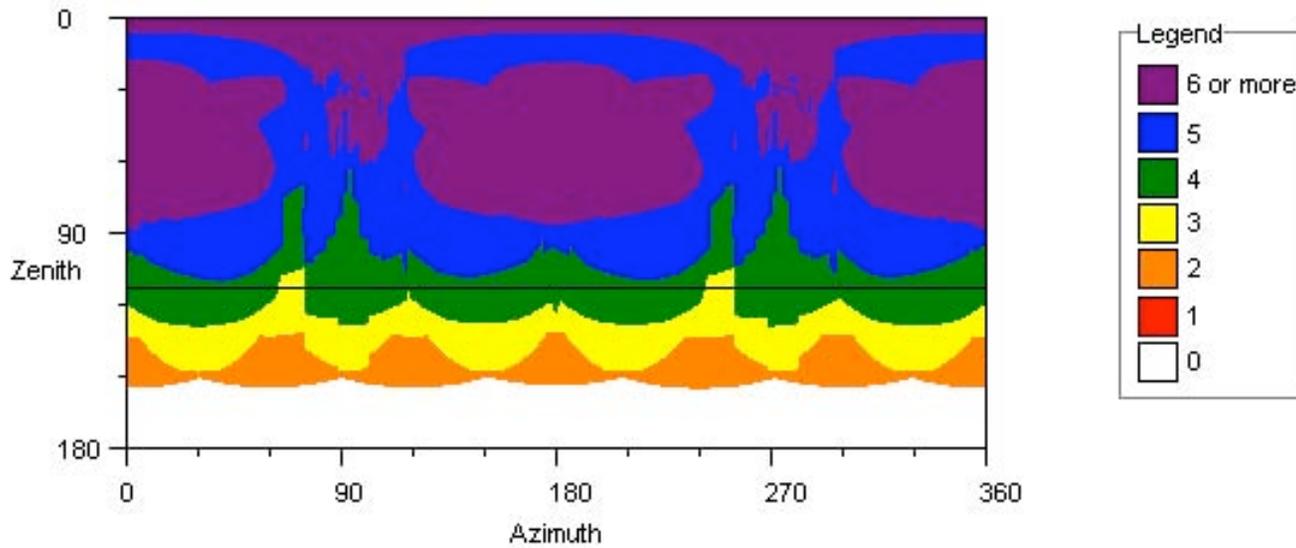
λ **Goal: 10 steradians**



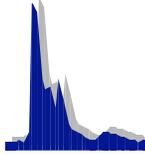
Effective area in units of detector area (front face only)

Ground Analysis Burst Sensitivity

Threshold Requirement: 0.5 photons/cm²-s; 5 sigma



Significance (sigma) of a GRB of 0.5 photons/cm²-s.
 RSS combination of all detectors with >2 sigma signal.



Performance Simulations

- ♠ **Uses preliminary response functions for typical burst spectrum; 50-300 keV**
- ♠ **Includes blockage by spacecraft, LAT, radiator, but not by solar panels, antennas, other GBM detectors.**
- ♠ **Background rates estimated from BATSE, extrapolated to 565 km altitude; include directional and orbital variations.**
- ♠ **Spacecraft and atmospheric scattering estimates included in location accuracy tests.**